PATENT ABSTRACTS OF JAPAN

(11)Publication number : 10-293559
(43)Date of publication of application : 04.11.1998

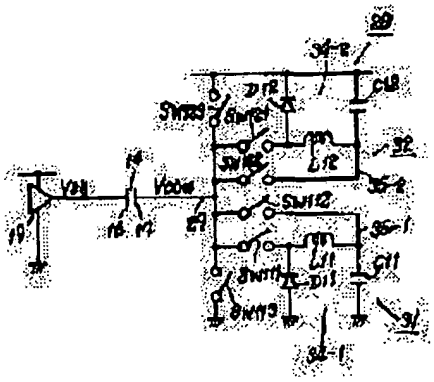
(51)Int.Cl. G09G 3/36
G02F 1/133
G02F 1/136
G02F 1/136

(21)Application number : 09-100150
(22)Date of filing : 17.04.1997

(71)Applicant : TOSHIBA CORP
(72)Inventor : HIRAI YASUKATSU
SAGI SEIICHI
HORI YOICHI

(54) LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce the power consumption is simple constitution while keeping high image quality as it is by providing a first and a second charge reusing circuits for supplying electric charges recovered at the time of next polarity inversion succeeding to each polarity inversion to a liquid crystal display element.
SOLUTION: A first charge reusing circuit 31 reuses the electric charge charged in a liquid crystal display element 14 when the potential of a common electrode 17 is positive to a pixel electrode 16, the electric charge is recovered to a positive state being the same polarity as that of the common electrode 17 just before the inversion of polarity and the recovered electric charge is again supplied to the liquid crystal display element 14 at the time of polarity inversion to the positive succeeding to the negative polarity inversion. A second charge reusing circuit 31 reuses the electric charge charged in a liquid crystal display element 14 when the potential of the common electrode 17 is negative to the pixel electrode 16, the electric charge is recovered to a negative state being the same polarity as that of the common electrode 17 just before the inversion of polarity and the recovered electric charge is again supplied to the liquid crystal display element 14 at the time of polarity inversion to the negative succeeding to the positive polarity inversion.



LEGAL STATUS
[Date of request for examination]
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the liquid crystal display which attained low-power-ization.
[0002]
[Description of the Prior Art] Generally, the liquid crystal display is widely used as a flat panel display for a word processor or personal computers, and expansion-izing of a screen product and improvement in definition are desired. and -- recent years -- from 10.4 inches, by VGA, 800x600 is produced commercially by 640x480 and SVGA, and, as for magnitude, 1024x768 is produced commercially by XGA, as for 12.1 inches and the number of pixels. Moreover, it is desired for these devices to have a main pocket form and for the long duration actuation by the cell to be possible.

[0003] Moreover, since driver voltage of a liquid crystal display is low, compared with a plasma display or an EL display, power consumption is small in each stage. However, by the pocket device of a cell drive, the power consumption of a liquid crystal display occupies 30 percent of the whole device, and a big part, and much more low-power-ization is desired.
[0004] Until now, low-power-ization is made by low-power-izing of the driver IC which drives a liquid crystal panel, improvement in efficiency of a power circuit, improvement in efficiency of the back light which illuminates a liquid crystal panel, etc. However, it is coming to the limitation only by these improvements, reduction-ization of the power consumption for driving a liquid crystal panel is also needed, and the approach using the liquid crystal which operates by the low battery, the approach of lowering drive frequency, etc. have been used as the reduction technique of power of driving a liquid crystal panel.
[0005] However, in the liquid crystal display using such a liquid crystal panel drive power reduction approach, display unevenness will occur with time or a flicker will occur. For example, in the property that a presentation tends to change, by the approach of making drive frequency low, a flicker becomes easy to be visible [the liquid crystal of low-battery actuation] to a screen, aging, such as presentation change of liquid crystal and a thin film transistor (Thin Film Transistor), also serves as unevenness on a screen, and it tends [further] to appear again.
[0006] Here, it is necessary to drive liquid crystal by perfect alternating current, and the potential of the common electrode of the liquid crystal display component used as each pixel is reversed the fixed period to the signal level which joins a pixel electrode. As a common electrode drive circuit for this, the circuit as shown by the former, for example, drawing 10 , is used. This drive circuit pressures partially two kinds of common electrical potential differences Vcom1 and Vcom2 by the series regulator which consists supply voltage of two or more resistance, and is two switches SW1 and SW2 about these common electrical potential differences Vcom1 and Vcom2. The voltage waveform which switches by turns and carries out sequential change as drawing 11 shows has been obtained.
[0007] Since recovery reuse is not carried out and the charge accumulated in a liquid crystal display component has loss by the series regulator in the liquid crystal display using such a drive circuit, the power consumption is as large as about 800mW.
[0008]
[Problem(s) to be Solved by the Invention] Thus, in the liquid crystal display, much more reduction-ization of power consumption is desired in consideration of the cell drive, without being accompanied by deterioration of display grace.
[0009] This invention was made in view of the above-mentioned trouble, and aims at offering the liquid crystal display which realized low-power-ization by the simple configuration, with high definition maintained.
[0010]

[Means for Solving the Problem] This invention prepares the pixel electrode controlled by the switching element and this switching element by the intersection of two or more signal lines and two or more scanning lines, respectively. In the liquid crystal display which carries out opposite arrangement of the common electrode through liquid crystal to these pixel electrode, constitutes a liquid crystal display component, is made to carry out sequential reversal of the polarity of the common electrode to said pixel electrode, and is driven The charge accumulated in the liquid crystal display component to said pixel electrode when a common electrode was forward The 1st charge reuse circuit which supplies said collected charge to said liquid crystal display component at the time of the following polarity reversals which collect as an electrical potential difference of said common electrode and like-pole nature, and follow these polarity reversals just before polarity reversals, The charge accumulated in the liquid crystal display component to said pixel electrode when a common electrode was negative It collects as an electrical potential difference of said common electrode and like-pole nature just before polarity reversals, and the 2nd charge reuse circuit which supplies said collected charge to said liquid crystal display component at the time of the following polarity reversals following these polarity reversals is provided.

[0011] Moreover, the 1st charge reuse circuit and the 2nd charge reuse circuit When it is the polarity to which a common electrode corresponds, become fixed period ON just before polarity reversals, and make it store in a coil by making into a field the charge accumulated in the liquid crystal display component at this "on" period, and the electrical potential difference produced among end-winding children after this "on" period is rectified. It has the charge recovery circuit which makes the electrical potential difference of the polarity accumulated in said liquid crystal display component, and like-pole nature stored in a capacitor, and the re-supply circuit which is turned on at the time of the following polarity reversals following said polarity reversals, and re-supplies said collected charge to said liquid crystal display component.

[0012] And just before the polarity of a common electrode is reversed, the charges accumulated in the liquid crystal display component are collected as an electrical potential difference of a common electrode and like-pole nature, this collected charge is supplied to a liquid crystal display component to the timing from which the polarity of a common electrode turns into a recovery electrical potential difference and like-pole nature, and a liquid crystal display component drives it. Although, as for the liquid crystal display component, the charge is charged as a capacitor at the time of a drive, this charge discharges, in case the polarity of the terminal voltage of a liquid crystal display component is reversed, it makes this discharge current stored, and is collected as an electrical potential difference of a common electrode and like-pole nature in a charge recovery circuit. And a liquid crystal display component is re-supplied to the drive timing from which the polarity of a common electrode turns into a recovery electrical potential difference and like-pole nature. By repeating such actuation for every inversion of a liquid crystal display component, the power consumption which the drive of a liquid crystal display component takes is reduced.

[0013] Furthermore, this invention prepares the pixel electrode controlled by the switching element and this switching element by the intersection of two or more signal lines and two or more scanning lines, respectively. In the liquid crystal display which carries out opposite arrangement of the common electrode through liquid crystal to these pixel electrode, constitutes a liquid crystal display component, is made to carry out sequential reversal of the polarity of the common electrode to said pixel electrode, and is driven The charge accumulated in the liquid crystal display component to said pixel electrode when a common electrode was forward The 1st charge reuse circuit which collects as an electrical potential difference of said common electrode and reversed polarity, and supplies said collected charge for said liquid crystal display component just before polarity reversals at the time of polarity reversals, The charges accumulated in the liquid crystal display component to said pixel electrode when a common electrode was negative are collected as an electrical potential difference of said common electrode and reversed polarity just before polarity reversals, and the 2nd charge reuse circuit which supplies said collected charge to said liquid crystal display component at the time of these polarity reversals is provided.

[0014] Moreover, the 1st charge reuse circuit and the 2nd charge reuse circuit When it is the polarity to which a common electrode corresponds, become fixed period ON just before polarity reversals, and make it store in a coil by making into a field the charge accumulated in the liquid crystal display component at this "on" period, and the electrical potential difference produced among end-winding children after this "on" period is rectified. It has the charge recovery circuit which makes the electrical potential difference of the polarity accumulated in said liquid crystal display component, and reversed polarity stored in a capacitor, and the re-supply circuit which is turned on at the time of said polarity reversals, and re-supplies said collected charge to a liquid crystal display component.

[0015] And just before the polarity of a common electrode is reversed, since the charges accumulated in the liquid crystal display component are collected as an electrical potential difference of reversed polarity with a common

electrode and this collected charge is supplied to a liquid crystal display component to the drive timing from which the polarity of a common electrode turns into a recovery electrical potential difference and reversed polarity, the range of the upper limit of the electrical potential difference which joins a common electrode, and a minimum can be expanded more than a power range, and, moreover, power consumption is reduced.

[0016] Furthermore, it is prepared for every capacitor of each charge recovery circuit, and the coil which corresponds so that it may turn on, OFF actuation of the terminal voltage of these capacitors may be carried out with the output of the comparator in comparison with reference voltage and these comparators and the terminal voltage of a corresponding capacitor may become equal to reference voltage is equipped with the switching regulator circuit which supplies supply voltage.

[0017] And since power consumption was reduced and the electrical potential difference of a common electrode is stable while the electrical potential difference of a common electrode is stabilized, since the switching regulator circuit which carries out an on-off action with the output of a comparator was prepared so that the terminal voltage of each capacitor for charge recovery might become equal to reference voltage, neither a flicker nor display nonuniformity arises and good image quality is maintained.

[0018]

[Embodiment of the Invention] Hereafter, the gestalt of 1 operation of the liquid crystal display of this invention is explained with reference to a drawing.

[0019] As a liquid crystal panel is shown in drawing 1 , it is TFT-LCD of 800x600 dots, and 800 signal lines 11 which are plurality, and the 600 scanning lines 12 which are plurality are wired by this liquid crystal panel in the shape of a grid through the insulating layer which is not illustrated. Moreover, the thin film transistor (Thin Film Transistor) 13 as a switching element is formed in each intersection of these signal lines 11 and the scanning line 12, respectively. The drain electrode is connected to a signal line 11, a gate electrode is connected to the scanning line 12, and, as for each thin film transistor 13, the liquid crystal display component 14 and the auxiliary capacity 15 are connected to the source electrode, respectively. The liquid crystal display component 14 has the pixel electrode 16 and the common electrode 17 by which opposite arrangement was carried out where liquid crystal is put to this pixel electrode 16, and a display drive is carried out with turning on and off of a thin film transistor 13.

[0020] Moreover, 19 is the signal-line driver section, this signal-line driver section 19 has the shift register 20, the latch 21, and the D/A transducer 22, and a shift register 20 is a timing pulse STH. Shift clock phi 1 Popularity is won and indicative-data DATA is incorporated one by one to the corresponding latch 21. And when indicative-data DATA is accumulated in all latches 21, each latch 21 is the scan shift clock phi 2 which is a Horizontal Synchronizing signal. Indicative-data DATA received and accumulated is outputted to the corresponding D/A transducer 22. Moreover, the D/A transducer 22 changes this indicative-data DATA into analog voltage, and outputs it to the signal line 11 which corresponds through a buffer. In addition, the R-DAC mold which carries out resistance division of during this period in response to logic supply voltage is used for the D/A transducer 22.

[0021] Furthermore, it is the scan timing pulse STV whose shift register 25 24 is the scanning-line driver section, this scanning-line driver section 24 has a shift register 25 and the switch section 26, and is a Vertical Synchronizing signal. Scan shift clock phi 2 It is the scan timing pulse STV by winning popularity. The sequential shift is carried out. Moreover, the switch section 26 is the scan timing pulse STV. Thin film transistor 26a as a switching element of the pair which turns on and carries out OFF actuation complementary by existence, and 26b It has and they are these thin film transistor 26a and 26b. The electrical potential difference Vg1 which changes mutually with actuation, and Vg2 It chooses and is outputted to the scanning line 12 which corresponds as a scan pulse in every line.

[0022] Moreover, as shown in drawing 2 , the common electrode drive circuit 28 has connected the path cord 29 to the common electrode 17 of the liquid crystal display component 14, as drawing 3 shows, and it is the common electrical potential difference Vcom of this common electrode 17. Signal level Vsig of the pixel electrode 16 It receives, and sequential polarity reversals are carried out and an alternating-voltage drive is carried out. This common electrode drive circuit 28 has two charge reuse circuits 31 and 32 for reusing the charge charged by the liquid crystal display component 14.

[0023] The 1st charge reuse circuit 31 is what reuses the charge charged by the liquid crystal display component 14 to the pixel electrode 16 when the potential of the common electrode 17 was forward here. These charges are collected just before polarity reversals in the forward condition which is the common electrode 17 and like-pole nature, and this collected charge is re-supplied to the liquid crystal display component 14 at the time of the forward polarity reversals of the degree following negative polarity reversals. Moreover, the 2nd charge reuse circuit 32 is what reuses the charge charged by the liquid crystal display component 14 to the pixel electrode 16 when the potential of the common

electrode 17 was negative. These charges are similarly collected just before polarity reversals in the negative condition which is the common electrode 17 and like-pole nature, and this collected charge is re-supplied to the liquid crystal display component 14 at the time of the negative polarity reversals of the degree following forward polarity reversals. And these two charge reuse circuits 31 and 32 operate complementary.

[0024] The charge reuse circuit 31 of these 1st and the 2nd charge reuse circuit 32 have the charge recovery circuit 34 and the re-supply circuit 35 of a charge, respectively, and explain the charge recovery circuit 34-1 and the re-supply circuit 35-1 which were established in the 1st charge reuse circuit 31.

[0025] First, the charge recovery circuit 34-1 is the switch SW111 formed between the path cord 29 to the common electrode 17, and the ground at the serial, the coil L11 in which a charge is stored temporarily, and the capacitor C11 for charge recovery. Coil L11 And switch SW111 Diode D11 which connected the rectification direction to the reverse sense between between and a ground side It has. This charge recovery circuit 34-1 is a switch SW111, just before the common electrode 17 is a forward polarity to the pixel electrode 16 and a polarity is reversed to negative. It is made a fixed period ON state. And it is a coil L11 about the charge accumulated in the liquid crystal display component 14 at this "on" period. It is made to store as a field. Then, switch SW111 It is made an OFF state and is a coil L11. It is diode D11 about the electrical potential difference produced between terminals. It rectifies and is a capacitor C11. It receives and the electrical potential difference of the polarity accumulated in the liquid crystal display component 14 and like-pole nature is made to be stored.

[0026] Moreover, the re-supply circuit 35-1 is a capacitor C11. Switch SW112 formed between the positive-electrode side edge child and the path cord 29 to the common electrode 17 It has. And this re-supply circuit 35-1 is a switch SW112. It is turned on [fixed period] at the time of polarity reversals forward [following negative polarity reversals], and is a capacitor C11. The collected charge is re-supplied to the liquid crystal display component 14.

[0027] Furthermore, switch SW113 It is a switch for an insufficiency supplement, and it will be prepared between the path cord 29 to the common electrode 17, and a ground, and will be in an ON state at the time of negative charge supply, and ground potential is supplied to the common electrode 17 that the insufficiency by the loss of circuit should be filled up.

[0028] Moreover, the 2nd charge reuse circuit 32 also has the charge recovery circuit 34-2 and the re-supply circuit 35-2 of a charge, respectively, and although it is fundamentally the same, a polarity differs from the charge recovery circuit 34-1 which prepared these in the 1st charge reuse circuit 31, and the re-supply circuit 35-1 of a charge.

[0029] That is, the charge recovery circuit 34-2 is the switch SW121 formed at the serial between the path cord 29 to the common electrode 17, and the positive-electrode power-source line, the coil L12 in which a charge is stored temporarily, and the capacitor C12 for charge recovery. Coil L12 And switch SW121 Diode D12 which made reverse sense connection of the rectification direction between positive-electrode power-source lines between It has. This charge recovery circuit 34-2 is a switch SW121, just before the common electrode 17 is a negative polarity to the pixel electrode 16 and a polarity is just reversed. It is made a fixed period ON state. And it is a coil L12 about the charge accumulated in the liquid crystal display component 14 at this "on" period. It is made to store as a field. Then, switch SW121 It is made an OFF state and is a coil L12. Diode D12 rectifies the electrical potential difference produced between terminals, and it is a capacitor C12. It receives and the electrical potential difference of the polarity accumulated in the liquid crystal display component 14 and like-pole nature is made to be stored.

[0030] Moreover, the re-supply circuit 35-2 is a capacitor C12. Switch SW122 formed between the negative-electrode side edge child and the path cord 29 to the common electrode 17 It has. This re-supply circuit 35-2 is a switch SW122. It is made a fixed period ON state at the time of polarity reversals negative [following forward polarity reversals], and is a capacitor C12. The collected charge is re-supplied to the liquid crystal display component 14.

[0031] Furthermore, switch SW123 It is a switch for an insufficiency supplement, and it will be prepared between the path cord 29 to the common electrode 17, and a positive-electrode power-source line, and will be in an ON state at the time of positive charge supply, and forward power-source potential is supplied to the common electrode 17 that the insufficiency by the loss of circuit should be filled up.

[0032] Next, actuation is explained with reference to drawing 3 and drawing 4 .

[0033] Signal level Vsig impressed to the pixel electrode 16 of the liquid crystal display component 14 from the signal-line driver section 19 This signal level Vsig Common electrical potential difference Vcom impressed to the common electrode 17 so that the receiving polarity may carry out sequential reversal Relation and each switch SW111 which constitutes the common electrode drive circuit 28 Or switch SW123 Timing of operation and charge recovery, and re-supply actuation are explained with reference to drawing 4 .

[0034] It sets to drawing 4 and is the common electrical potential difference Vcom. Signal level Vsig It receives, is a

positive electrode and is a switch SW123. Switch SW111 formed in the charge recovery circuit 34-1 of the 1st charge reuse circuit 31 just before this polarity was reversed, when turning OFF and making it reversed to a negative-electrode side (t11) It is made a predetermined period (up to t12) ON state. Switch SW111 By having been turned on, the charge accumulated in the liquid crystal display component 14 is a coil L11. It is stored as a field. Then, switch SW111 When off actuation is carried out, it is a coil L11. An electrical potential difference occurs in both ends, and it is diode D11. It is rectified and is a capacitor C11. It charges. The polarity at this time is forward [of the time of the liquid crystal display component 14 charging, and like-pole nature]. Namely, capacitor C11 An illustration up terminal serves as a positive electrode.

[0035] Thus, capacitor C11 The collected charge is the switch SW112 of the re-supply circuit 35-1 of a charge at the time of polarity reversals forward from negative [following polarity reversals negative from forward]. The liquid crystal display component 14 is re-supplied by carrying out ON actuation (t15).

[0036] namely, common electrical potential difference Vcom Signal level Vsig the time (t14) of receiving and changing polarity reversals into a forward condition from a negative condition -- next time -- switch SW 121t15 of the 2nd charge reuse circuit 32 up to -- the charge of the negative polarity which would be in the between ON state and was accumulated in the liquid crystal display component 14 by the same actuation as the above-mentioned -- coil L12 pass -- capacitor C12 It is collected. Then, switch SW112 of the 1st charge reuse circuit 31 By carrying out ON actuation (t15), it is a capacitor C11 at the time of polarity reversals negative from forward [last]. The collected positive charge is re-supplied to the liquid crystal display component 14.

[0037] Moreover, it is the capacitor C12 of the 2nd charge reuse circuit 32 at the time of polarity reversals forward from negative [before that] to the time of polarity reversals negative from forward. The negative charge currently collected is the switch SW122 of the re-supply circuit 35-2 of a charge. The liquid crystal display component 14 is re-supplied by carrying out ON actuation (t12).

[0038] In addition, since the charge of the liquid crystal display component 14 does not have theoretically being collected 100% for the loss of circuit, The re-supply circuit 35-2 of a charge, the switch SW122 of 35-1, and SW112 After carrying out ON actuation and carrying out re-supply (t12, t15) of the recovery charge to the liquid crystal display component 14, A switch SW122 and SW112 After making it turn off, ON actuation of the switch SW113 for a supplement and SW123 is carried out in order to compensate an insufficiency (t13, t16), and the polar corresponding power source is supplied.

[0039] Thus, two charge reuse circuits 31 and 32 are the common electrical potential differences Vcom. It operates complementary, whenever a polarity is reversed. That is, the power consumption which the drive of a liquid crystal panel takes can be reduced by re-supplying a recovery charge from the 1st charge reuse circuit 31 immediately after re-supplying the charge before collected from the 2nd charge reuse circuit 32 immediately after collecting charges to the liquid crystal display component 14 in the 1st charge reuse circuit 31, and collecting charges in the 2nd charge reuse circuit 32.

[0040] In addition, according to the experiment, with the gestalt of this operation, while being able to reduce power consumption by 200mW compared with the former, it was not generated but a flicker, display unevenness, etc. have maintained good image quality.

[0041] Next, the gestalt of other operations is explained with reference to drawing 5 .

[0042] Although the liquid crystal panel itself is the same structure as what was shown by drawing 1 R> 1, the common electrode drive circuit 28 consists of gestalten of this operation, as drawing 5 shows.

[0043] The common electrode drive circuit 28 shown in this drawing 5 has also connected that path cord 29 to the common electrode 17 of the liquid crystal display component 14, and is the common electrical potential difference Vcom of this common electrode 17. Signal level Vsig of the pixel electrode 16 It receives, and sequential polarity reversals are carried out and an alternating-voltage drive is carried out. Moreover, this common electrode drive circuit 28 has two charge reuse circuits 41 and 42 for reusing the charge charged by the liquid crystal display component 14.

[0044] Here, to the pixel electrode 16, when the potential of the common electrode 17 is forward, the 1st charge reuse circuit 41 reuses the charge charged by the liquid crystal display component 14, collects these charges in the negative condition which is the common electrode 17 and reversed polarity just before polarity reversals negative from forward, and re-supplies this collected charge to the liquid crystal display component 14 at the time of polarity reversals negative from forward.

[0045] Moreover, to the pixel electrode 16, when the potential of the common electrode 17 is negative, the 2nd charge reuse circuit 42 reuses the charge charged by the liquid crystal display component 14, collects these charges in the forward condition which is the common electrode 17 and reversed polarity just before polarity reversals forward from

negative, and re-supplies this collected charge to the liquid crystal display component 14 at the time of polarity reversals forward from negative. That is, these two charge reuse circuits 41 and 42 operate complementary.
[0046] The charge reuse circuit 41 of these 1st and the 2nd charge reuse circuit 42 have the charge recovery circuit 44 and the re-supply circuit 45 of a charge, respectively.
[0047] First, the charge recovery circuit 44-1 and the re-supply circuit 45-1 which were established in the 1st charge reuse circuit 41 are explained.
[0048] The charge recovery circuit 44-1 is the switch SW211 formed in the serial between the path cord 29 to the common electrode 17, and the ground. And coil L21 in which a charge is stored temporarily This coil L21 It is diode D21 to both ends. Capacitor C21 for charge recovery connected by minding It has. In addition, diode D21 The rectification direction is a coil L11. Both ends to capacitor C21 It sets up so that the polarity of the electrical potential difference collected may turn into reversed polarity to the electrical potential difference currently stored in the liquid crystal display component 14.
[0049] Moreover, in this charge recovery circuit 44-1, the common electrode 17 is a switch SW211, just before a polarity is reversed to negative to the pixel electrode 16 at a forward polarity. It is made a fixed period ON state. And it is a coil L21 about the charge accumulated in the liquid crystal display component 14 at this "on" period. It is made to store as a field. Then, switch SW211 It is made an OFF state and is a coil L21. It is diode D21 about the electrical potential difference produced between terminals. It rectifies and is a capacitor C21. It receives and the negative electrical potential difference which is the polarity and reversed polarity which were accumulated in the liquid crystal display component 14 is made to be stored.
[0050] Furthermore, the re-supply circuit 45-1 is a capacitor C21. Switch SW212 formed between the negative-electrode side edge child and the path cord 29 to the common electrode 17 It has. This re-supply circuit 45-1 is a switch SW212. It is turned on at the time of negative polarity reversals, and is a capacitor C21. The collected charge is re-supplied to the liquid crystal display component 14.
[0051] Switch SW213 It is a switch for an insufficiency supplement and is a coil L21. It is a coil L21 that it should be prepared between an anti-earthed pole terminal and a forward power-source line, ON and off actuation should be repeated a predetermined period at the time of negative-electrode charge supply, and the insufficiency by the loss of circuit should be filled up. A forward power source is supplied and it is diode D21. It minds and is a capacitor C21. The electrical potential difference of reversed polarity is made to charge.
[0052] The 2nd charge reuse circuit 42 also has the charge recovery circuit 44-2 and the re-supply circuit 45-2 of a charge, respectively. Although it is fundamentally the same, a polarity differs from the charge recovery circuit 44-1 which established these charges recovery circuit 44-2 and the re-supply circuit 45-2 of a charge in the 1st charge reuse circuit 41, and the re-supply circuit 45-1 of a charge.
[0053] That is, the charge recovery circuit 44-2 is the switch SW221 formed in the serial between the path cord 29 to the common electrode 17, and the positive-electrode power-source line. And coil L22 in which a charge is stored temporarily This coil L22 It is diode D22 to both ends. Capacitor C22 for charge recovery connected by minding It has. In addition, diode D22 The rectification direction is a coil L22. Both ends to capacitor C22 It sets up so that the polarity of the electrical potential difference collected may turn into reversed polarity to the electrical potential difference currently stored in the liquid crystal display component 14.
[0054] In this charge recovery circuit 44-2, the common electrode 17 is a switch SW221, just before a polarity is just reversed to the pixel electrode 16 at a negative polarity. It is made a fixed period ON state. And it is a coil L22 about the charge accumulated in the liquid crystal display component 14 at this "on" period. It is made to store as a field. Then, switch SW221 It is made an OFF state and is a coil L22. It is diode D22 about the electrical potential difference produced between terminals. It rectifies and is a capacitor C22. It receives and the forward electrical potential difference which is the polarity and reversed polarity which were accumulated in the liquid crystal display component 14 is made to be stored.
[0055] Moreover, the re-supply circuit 45-2 is a capacitor C22. Switch SW222 formed between the positive-electrode side edge child and the path cord 29 to the common electrode 17 It has. This re-supply circuit 45-2 is a switch SW222. It is turned on at the time of forward polarity reversals, and is a capacitor C22. The collected charge is re-supplied to the liquid crystal display component 14.
[0056] furthermore, switch SW223 the switch for an insufficiency supplement -- it is -- coil L22 the insufficiency are prepared between an anti-power-source line side edge child and a ground, repeat ON and OFF actuation a predetermined period at the time of positive-electrode charge supply, and according to the loss of circuit -- it should supply -- coil L22 and the diode D22 -- minding -- capacitor C22 The forward electrical potential difference which is

reversed polarity is made to charge.
[0057] Next, actuation is explained with reference to drawing 6 .
[0058] Signal level Vsig impressed to the pixel electrode 16 of the liquid crystal display component 14 from the signal-line driver section 19 This signal level Vsig Common electrical potential difference Vcom impressed to the common electrode 17 so that the receiving polarity may carry out sequential reversal Relation and each switch SW211 which constitutes the common electrode drive circuit 28 Or SW223 The charge recovery and re-supply actuation accompanying timing of operation and it are explained with reference to drawing 6 .
[0059] As shown in drawing 6 , it is the common electrical potential difference Vcom. Signal level Vsig Switch SW211 which it received and was a positive electrode, and was formed in the charge recovery circuit 44-1 of the 1st charge reuse circuit 41 just before this polarity was reversed, when making it reversed to a negative-electrode side (t21) It is made a predetermined period (up to t22) ON state. Switch SW211 By having been turned on, the charge accumulated in the liquid crystal display component 14 is a coil L21. It is stored as a field. Then, switch SW211 When off actuation is carried out (t22), it is a coil L21. An electrical potential difference occurs in both ends, and it is diode D21. It is rectified and is a capacitor C21. It charges. The polarity at this time is negative [which is the charge and reversed polarity which were accumulated in the liquid crystal display component 14]. Namely, capacitor C21 An up terminal serves as a negative electrode.
[0060] At the time of polarity reversals negative from forward [this], it is the switch SW212 of the re-supply circuit 45-1 of a charge to coincidence (t22). ON actuation is carried out and it is a capacitor C21. The collected negative charge is re-supplied to the liquid crystal display component 14.
[0061] Moreover, switch SW213 for an insufficiency supplement to coincidence (t22) It will be in a predetermined period ON state, and is a coil L21. It receives and a power source is supplied from a positive supply line. Then, switch SW213 The electrical potential difference produced to both ends by what is done for off actuation (t23) is diode D21. It is rectified and is a capacitor C21. While being accumulated, that negative charge is the switch SW212 of an ON state. It passes and the liquid crystal display component 14 is supplied. this switch SW213 an on-off action is repeated several times -- having -- whenever [that] -- capacitor C21 from -- since negative charge is supplied to the liquid crystal display component 14, the insufficiency by the loss of circuit is filled up and the common electrode 17 is stabilized in predetermined electronegative potential.
[0062] Next, common electrical potential difference Vcom Signal level Vsig When it receives and inverts in the forward condition from a negative condition just before that (t24) -- switch SW 221t25 of the 2nd charge reuse circuit 42 It will be in a between ON state. up to -- by the same actuation as the above-mentioned The charge of the negative polarity accumulated in the liquid crystal display component 14 is a coil L22. It is once stored and is a switch SW221. By off actuation (t25), it is a capacitor C22. It is collected by the forward condition that the are recording condition in the liquid crystal display component 14 is reversed polarity. Namely, capacitor C22 A lower terminal serves as a positive electrode.
[0063] At the time of polarity reversals forward from negative [this], it is the switch SW222 of the re-supply circuit 45-2 of a charge to coincidence (t24). ON actuation is carried out and it is a capacitor C22. The collected positive charge is re-supplied to the liquid crystal display component 14.
[0064] Moreover, SUICHI SW223 for an insufficiency supplement to coincidence (t24) By being in a predetermined period ON state, it is a coil L22. A ground is connected to an illustration lower limit and a power source is supplied to it from a positive supply line. Then, switch SW223 By what is done for off actuation (t25), it is a coil L22. The electrical potential difference produced to both ends is diode D22. It is rectified and is a capacitor C22. It is accumulated. And the positive charge is the switch SW222 of an ON state. It passes and the liquid crystal display component 14 is supplied. this switch SW223 ON and off actuation are repeated several times -- having -- whenever [that] -- capacitor C22 from -- since positive charge is supplied to the liquid crystal display component 14, the insufficiency by the loss of circuit is filled up and the common electrode 17 is stabilized in predetermined electropositive potential.
[0065] The electrical potential difference re-supplied to the liquid crystal display component 14 here from the 1st charge reuse circuit 41 corresponding to the time of polarity reversals or the 2nd charge reuse circuit 42 is the common electrical potential difference Vcom, as drawing 6 shows, since it is a polar electrical potential difference contrary to the charge accumulated in the liquid crystal display component 14 in front of polarity reversals. An upper limit and a minimum are expandable more than supply voltage. That is, the electrical potential difference exceeding supply voltage can be impressed to the liquid crystal display component 14. According to the experiment, with the gestalt of this operation, the electrical potential difference of 3.3V was able to be impressed to the liquid crystal

display component 14 with the supply voltage of 2.5V.
[0066] Compared with the case where the conventional power source of 3.3V is used, 250mW of power consumption for the liquid crystal panel drive in this case was able to be made small. Moreover, it was not generated but a flicker, display unevenness, etc. were able to maintain good image quality.
[0067] Next, the gestalt of other operations is explained with reference to drawing 7 . The common electrode drive circuit 28 of the gestalt of this operation also has two charge reuse circuits 51 and 52. These charges reuse circuits 51 and 52 have the same charge recovery circuit 54 and the re-supply circuit 55 of a charge fundamentally with what was shown by drawing 3 , respectively.
[0068] First, the charge recovery circuit 54-1 and the re-supply circuit 55-1 which were established in the 1st charge reuse circuit 51 are explained.
[0069] This charge recovery circuit 54-1 is the switch SW311 formed between the path cord 29 to the common electrode 17, and the ground at the serial, the coil L31 in which a charge is stored temporarily, and the capacitor C31 for charge recovery. A switch SW311 and coil L31 Diode D31 which made reverse sense connection of the rectification direction between between and a ground side It has. The common electrode 17 is a forward polarity to the pixel electrode 16, and this charge recovery circuit 54-1 makes a switch SW311 a fixed period ON state, just before a polarity is reversed to negative. And it is a coil L31 about the charge accumulated in the liquid crystal display component 14 at this "on" period. It is made to store as a field. Then, switch SW311 It is made an OFF state and is a coil L31. It is diode D31 about the electrical potential difference produced between terminals. It rectifies and is a capacitor C31. It receives and the electrical potential difference of the polarity accumulated in the liquid crystal display component 14 and like-pole nature is made to be stored.
[0070] Moreover, the re-supply circuit 55-1 is a capacitor C31. Switch SW312 formed between the positive-electrode side edge child and the path cord 29 to the common electrode 17 It has. This re-supply circuit 55-1 is a switch SW312. It is turned on [fixed period] at the time of polarity reversals forward [following negative polarity reversals], and is a capacitor C31. The collected charge is re-supplied to the liquid crystal display component 14.
[0071] The configuration so far is the switch SW113 for an insufficiency supplement in drawing 3 although it is the same as the charge recovery circuit 34-1 of drawing 3 , and the re-supply circuit 35-1. Switch SW313 which is replaced, and switches on and carries out OFF actuation with a comparator COMP11 and the output of this comparator COMP11 The switching regulator circuit which it has is constituted.
[0072] Moreover, a comparator COMP11 is a capacitor C31. Terminal voltage is compared with reference voltage Vcom1, and it is a capacitor C31. An output will be produced if terminal voltage becomes lower than reference voltage Vcom1. Switch SW313 A forward power-source line and a forward coil L31 It is prepared between ends, ON actuation is carried out with the output of a comparator COMP11, and it is a coil L31. Supply voltage is supplied.
[0073] The 2nd charge reuse circuit 52 also has the charge recovery circuit 54-2 and the re-supply circuit 55-2 of a charge, respectively. Although it is fundamentally the same, a polarity differs from the charge recovery circuit 54-1 which prepared these in the 1st charge reuse circuit 51, and the re-supply circuit 55-1 of a charge.
[0074] That is, the charge recovery circuit 54-2 is the switch SW321 formed at the serial between the path cord 29 to the common electrode 17, and the positive-electrode power-source line, the coil L32 in which a charge is stored temporarily, and the capacitor C32 for charge recovery. A switch SW321 and coil L32 Diode D32 which made reverse sense connection of the rectification direction between positive-electrode power-source lines between It has. This charge recovery circuit 54-2 is a switch SW321, just before the common electrode 17 is a negative polarity to the pixel electrode 16 and a polarity is reversed to forward. It is made a fixed period ON state. And it is a coil L32 about the charge accumulated in the liquid crystal display component 14 at this "on" period. It is made to store as a field. Then, switch SW321 It is made an OFF state and is a coil L12. It is diode D32 about the electrical potential difference produced between terminals. It rectifies and is a capacitor C32. It receives and the electrical potential difference of the polarity accumulated in the liquid crystal display component 14 and like-pole nature is made to be stored.
[0075] The re-supply circuit 55-2 is a capacitor C32. Switch SW322 formed between the negative-electrode side edge child and the path cord 29 to the common electrode 17 It has. This re-supply circuit 55-2 is a switch SW322. It is made a fixed period ON state at the time of polarity reversals negative [following forward polarity reversals], and is a capacitor C32. The collected charge is re-supplied to the liquid crystal display component 14.
[0076] Moreover, it has a switching regulator circuit as well as the 1st charge reuse circuit 51. This switching regulator circuit is the switch SW323 which carries out an on-off action with a comparator COMP12 and the output of this comparator COMP12. It has.
[0077] And a comparator COMP12 is a capacitor C32. Terminal voltage is compared with reference voltage Vcom2,

and it is a capacitor C32. An output will be produced if terminal voltage becomes lower than reference voltage Vcom2. Switch SW323 A ground and coil L32 It is prepared between ends, ON actuation is carried out with the output of a comparator COMP12, and it is a coil L32. Supply voltage is supplied.
[0078] Next, actuation is explained with reference to drawing 8 .
[0079] As shown in drawing 8 , it is the common electrical potential difference Vcom. Signal level Vsig Switch SW311 which it received and was a positive electrode, and was formed in the charge recovery circuit 54-1 of the 1st charge reuse circuit 51 just before this polarity was reversed, when making it reversed to a negative-electrode side (t31) It is made a predetermined period (up to t32) ON state. Switch SW311 By having been turned on, the charge accumulated in the liquid crystal display component 14 is a coil L31. It is stored as a field. Then, switch SW311 When off actuation is carried out, it is a coil L31. The electrical potential difference generated to both ends is diode D31. It is rectified and is a capacitor C31. It charges. The polarity at this time is straight polarity which is a time of the liquid crystal display component 14 charging, and like-pole nature. Namely, capacitor C31 An illustration up terminal serves as a positive electrode.
[0080] Thus, capacitor C31 The collected charge is the switch SW312 of the re-supply circuit 55-1 of a charge at the time of polarity reversals forward from negative [following polarity reversals negative from forward]. The liquid crystal display component 14 is re-supplied by carrying out ON actuation (t35).
[0081] Namely, common electrical potential difference Vcom Signal level Vsig When it receives and polarity reversals are changed into a forward condition from a negative condition (t34), it is the switch SW321 of the 2nd charge reuse circuit 52. Negative [which is the charge which would be in the between ON state to t35, and was accumulated in the liquid crystal display component 14 by the same actuation as the above-mentioned] is a coil L32. It passes and is a capacitor C32. It is collected. Then, switch SW312 of the 1st charge reuse circuit 51 By carrying out ON actuation (t35), it is a capacitor C31 at the time of polarity reversals negative from forward [last]. The collected charge of straight polarity is re-supplied to the liquid crystal display component 14.
[0082] Moreover, it is the capacitor C52 of the 2nd charge reuse circuit 52 at the time of polarity reversals forward from negative [before that] to the time of polarity reversals negative from forward. A charge is the switch SW322 of the re-supply circuit 55-2 of a charge to negative [which were collected]. The liquid crystal display component 14 is re-supplied by carrying out ON actuation (t32).
[0083] here -- switches SW312 or SW322 of the re-supply circuit 55-1 of a charge, or the re-supply circuit 55-2 of a charge Capacitor C31 accompanying ON actuation Or capacitor C32 from -- at the time of charge re-supply for the liquid crystal display component 14 For example, capacitor C31 If it attaches, when the terminal voltage will become lower than reference voltage Vcom1 with charge re-supply, a comparator COMP11 produces an output and it is a switch SW313. It is made to turn on (t36) and is a coil L31 from a positive-electrode power-source line. Supply voltage is applied. Then, this switch SW313 When off actuation is carried out, the electrical potential difference produced to the both ends of a coil L31 is diode D31. It is rectified and is a capacitor C31. While charging, it is the switch SW312 with an ON state. It passes and the liquid crystal display component 14 is supplied. Henceforth, capacitor C31 Since this actuation is repeated whenever terminal voltage becomes lower than reference voltage Vcom1, the common electrode 17 of the liquid crystal display component 14 is stabilized by reference voltage Vcom1.
[0084] This actuation is a capacitor C32. Although it is the same even if it attaches, and polarities differ, they are a comparator COMP12 and a switch SW323. The switching regulator which it has operates similarly and stabilizes the common electrode 17 of the liquid crystal display component 14 to reference voltage Vcom2.
[0085] Thus, compared with the common electrode drive circuit of the conventional series regulator mold, 250mW of power consumption for the drive of the constituted liquid crystal display panel decreased. Moreover, since the common electrical potential difference was stabilized, neither a flicker nor display unevenness arose, but good image quality was able to be maintained.
[0086] Next, the gestalt of other operations is explained with reference to drawing 9 .
[0087] For the common electrode drive circuit 28 by the gestalt of this operation, the circuit and most which were shown by drawing 5 are the switch SW213 in drawing 5 although it is common, and SW223. The switch SW413 which constitutes a switching regulator into a corresponding part, and SW423 It prepares and they are these switches SW413 and SW423. An on-off action is carried out with the corresponding comparators COMP21 and COMP22.
[0088] Here, a comparator COMP21 is a capacitor C21. Switch SW413 which produces the output to which terminal voltage becomes lower than reference voltage Vcom2, and corresponds ON actuation is carried out. A comparator COMP22 is a capacitor C22. Switch SW423 which produces an output and corresponds if terminal voltage becomes

lower than reference voltage Vcom1 ON actuation is carried out.
[0089] The common electrode drive circuit 28 is the common electrical potential difference Vcom of the liquid crystal display component 14 like the circuit of drawing 5 . Signal level Vsig When it receives and reverses negative from forward, stored charge is a capacitor C21 in the condition of reversed polarity just before reversal. Or capacitor C22 The common electrode 17 re-supplies the collected charge at the time of polarity reversals, and he is trying to apply the electrical potential difference which exceeds supply voltage to the liquid crystal display component 14.
[0090] In this case, it is a capacitor C21 by charge re-supply. Or capacitor C22 Switch SW413 with which a comparator COMP21 or a comparator COMP22 operates and corresponds if terminal voltage becomes lower than reference voltage Vcom2 or reference voltage Vcom1 Or it turns on and a switch SW423 carries out off actuation. For this reason, the corresponding coil L21 and diode D21 Or a coil L22 and diode D22 Capacitor C21 Or capacitor C22 It charges with supply voltage and this charge charge is supplied to the liquid crystal display component 14.
[0091] consequently, common electrical potential difference Vcom Signal level Vsig the time of receiving and being reversed from forward to negative -- switch SW212 minding -- capacitor C21 from -- since a charge is supplied to the liquid crystal display component 14, while the insufficiency by the loss of circuit is filled up, the common electrode 17 is stabilized by the negative reference voltage Vcom2. on the other hand, common electrical potential difference Vcom Signal level Vsig the time of receiving and being just reversed from negative -- switch SW222 minding -- capacitor C22 from -- since a charge is supplied to the liquid crystal display component 14, while the insufficiency by the loss of circuit is similarly filled up, the common electrode 17 is stabilized by the forward reference voltage Vcom1.
[0092] Thus, compared with the common electrode drive circuit of the conventional series regulator mold, 200mW of power consumption for the drive of the constituted liquid crystal display panel decreased. Moreover, since the common electrical potential difference was stabilized, neither a flicker nor display unevenness arose, but good image quality was able to be maintained.
[0093] With the gestalt of each operation which used such a switching regulator, it can also synchronize synchronizing an operation halt of switching regulator actuation with a Horizontal Synchronizing signal as mentioned above with a Vertical Synchronizing signal. Moreover, the switching frequency of a switching regulator can be set as the frequency of the arbitration more than a horizontal synchronization or vertical synchronous frequency.
[0094] In addition, at the drive timing chart used for explanation of the gestalt of each operation of operation, it is a signal level Vsig. Common electrical potential difference Vcom Although drawn on the same scale, it is the common electrical potential difference Vcom correctly. Signal level Vsig It is set as the potential which it received and was shifted by the gate thrust omission electrical potential difference of a thin film transistor.
[0095] moreover, any gestalt of operation -- the twist -- nematic -- it is applicable also to a liquid crystal display required for various kinds of liquid crystal drive method and polarity reversals, such as various kinds of liquid crystal modes, such as (TN) and IPS mode, electrode structure, an analog sample hold mold active matrix, a metal-insulator layer-metal (MIM) mold active matrix, and a passive matrix.
[0096]
[Effect of the Invention] Since polarity reversals are collected and re-supplied with the charge charged by the liquid crystal display component at the time of a drive according to this invention, a simple configuration can realize low-power-ization, with high definition maintained.

[Translation done.]